Preliminary Examination Questions for Jian Zeng

April 8, 2014

1. A central concept in animal improvement is the breeding value, and an estimate of the breeding value, typically obtained using mixed model methodology. Explain what BVs and EBVs are, separately in language appropriate for a) commercial producers; b) a biologist with some understanding of genetics; and c) a pure statistician.

2. A pig breeder wants to select on an index of body composition comprising 2*lean - 1*fat based on phenotypic measures of bodyweight and ultrasound measure.

   (a) Calculate the selection index weights. Phenotypic variances are: lean 100 kg², fat 64 kg², bodyweight 200 kg², ultrasound 16 mm²; heritabilities are 0.5, 0.6, 0.4, 0.3; phenotypic correlations are lean-fat 0.3, lean-bodyweight 0.7, lean-ultrasound 0.2, fat-bodyweight 0.8, fat-ultrasound 0.85, bodyweight-ultrasound 0.3; and genetic correlations are lean-fat 0.1, lean-bodyweight 0.9, lean-ultrasound 0.1, fat-bodyweight 0.5, fat-ultrasound 0.95, bodyweight-ultrasound 0.1.

   (b) What is the squared correlation between true and estimated merit for an individual with a bodyweight and ultrasound measure? How much is this value reduced if the individual does not have an observed ultrasound measure?

   (c) What is the likely annual response(s) to within-herd selection?

3. Explain from start to finish how to conduct an association study for

   (a) A quantitative trait

   (b) A recessive disorder

4. Give 2 problems that are important to address in animal breeding in the next 10 years.

5. A wealthy investor from Beijing is interested in investing in animal breeding and has hired you to develop a business plan for a new breeding company for a species of your choice in China. Assume that we are still in the pre-genomics area, so no markers.
(a) Describe how you would develop (from scratch) a multi-trait breeding program for this species, including development of the breeding goal, development of the total merit index (which traits to include and how would you derive the index weights), development of the data recording, genetic evaluation, and selection strategy, and how you would go about predicting expected responses to selection in the individual traits for the selection strategy of your choice, as well as predicting the expected rate of inbreeding. Be as specific as you can by specifying traits, equations, procedures you would use at each step, etc.

(b) For the breeding program under a), describe how you would go about doing a cost-benefit analysis, which is obviously something the investor would be interested in.

(c) Now assume that you successfully implemented this strategy 10 years ago and now, along comes genomics. How would you propose to change the strategy you developed above using genomics? Prepare the outline of a report that you would prepare for the investor to convince him to invest in genomics. Include details on how you would make the required predictions of response and inbreeding when implementing genomics.